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SPECTROPHOTOMETRIC QUANTIFICATION OF NITRITE AND NITRATE IN CURED PROCESSED MEAT

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ABSTRACT

A total of 115 samples of different cured meat products – locally processed and imported ones – were purchased from various groceries and supermarkets in Egypt then analyzed for their contents of both nitrite and nitrate by the aid of spectrophotometer and expressed as mg/kg (ppm). The surveyed samples consisted of 25 corned beef (9 locally processed plus 16 imported ones), 20 locally processed beef sausage, 15 locally processed patirma, 10 locally processed beef luncheon, 5 imported canned beef luncheon, 20 canned chicken sausage (8 locally processed and 12 imported ones), 10 imported canned chicken luncheon, in addition to 10 locally processed chicken luncheon samples.

Spectrophotometric analyses quantified the range (minimum – maximum) &mean ± S.E. levels of nitrite in the tissues of locally processed and imported corned beef samples as 4.35 – 43 & 14.59±4.13 mg/kg and 4.07 - 78.37 & 38.94±6.98 mg/kg, respectively, while similar findings for the nitrate were 13.91 - 40.58 & 22.8 ± 2.64 mg/kg and 12.32 - 102.5 & 43.88±6.62 mg/kg in the same samples, consequently, the sum of both nitrite and nitrate residues were calculated as 23.91 - 62.2 & 37.39±4.5 mg/kg in locally processed corned beef besides 30.77 - 141.9 & 82.82±9.2 mg/kg in imported corned beef samples, consecutively.

The aforementioned analytical technique exhibited the minima, maxima, and mean ± S.E. values of nitrite 6.65, 82, 28.72±4.34 mg/kg; of nitrate 8.93, 113.01, and 40.6 ± 5.94 mg/kg; of sum nitrite and nitrate 16.49, 138.7, and 69.33 ± 7.92 mg/kg, respectively, in the tissues of locally processed beef sausage. While, those findings were 2.03, 69, and 22.35±4.96 mg/kg for nitrite; 0.76, 114.25, and 54±10.42 mg/kg for nitrate; as well as 18.99, 142.71, and 76.35±10.06 mg/kg for sum nitrite and nitrate, successfully in the samples of locally processed pastirma.

The lowest levels of nitrite, nitrate, and sum nitrite and nitrate in the analyzed tissues of both locally processed beef luncheon and imported canned beef luncheon samples were 5.22 & 36.73, 1.99 & 2.99, and 18.99 & 63.29 mg/kg ; whereas the highest amounts of such residues were 75.5 &75.78, 74.7 & 59.56, and 131.7 & 96.29 mg/kg ; meanwhile the mean levels ± S.E. of these findings were 30.63 ± 8.28 & 59.22 ± 8.32, 32.81 ± 6.4 & 21.78 ± 11.16, and 63.43 ± 12.46 & 81 ± 6.81 mg/kg in the same samples, successfully.

Tissues of locally processed canned chicken sausage revealed nitrite nitrate, and sum nitrite/nitrate by levels ranged from 7.46 – 47.08, 7.5 - 44.8, and 22.06 - 91.88 mg/kg with mean ± S.E. values 27.54 ± 4.54, 16.22 ± 4.6, and 43.77 ± 7.96 mg/kg, respectively. While, those findings in surveyed samples of imported canned chicken sausage were 18.46 – 64.11, 2.65 – 93.78, 43.51 – 132.08 with mean ± S.E. values 39.21 ± 3.61, 29.07 ± 7.36, and 68.28 ± 7.07 mg/kg, consecutively.

The mean ± S.E. levels and ranges (minimum – maximum) of the investigated analytes in the samples of imported canned chicken luncheon were found 45.86 ± 9.37 and 21.69 - 99.52 mg/kg for nitrite, 49.55 ± 14.55 and 12.65 - 149.76 mg/kg for nitrate, in addition to 95.43 ± 16.03 and 46.59 - 198.36 mg/kg for sum nitrite/nitrate, respectively. Meanwhile, similar findings in the tissues of locally processed chicken luncheon were 35.96 ± 5.55 and 11.21 - 58.4 mg/kg for nitrite, 37.92 ± 9.05 and 1.06 - 99.81 for nitrate, as well as 73.88 ± 6.94 and 47.36 - 120.98 mg/kg for sum nitrite/nitrate, successfully.

An overviewing the obtained results, none of surveyed samples of cured meat products possessed nitrite or nitrate level more than their limits (150 & 250 mg/kg, respectively). Also, public health significance of nitrite and nitrate in cured meat products – marketed in Egypt – as well as the conclusion and recommendations of the present study were also mentioned.

INTRODUCTION

Processed meat and poultry are popular and extremely perishable food. Nitrites and nitrates are used in meat curing because they stabilize attractive red meat color, retard some spoilage and food poisoning anaerobic microorganisms, lateness the development of oxidative rancidity, and share to flavor development **(Jiménez-Colmenero and Solana, 2009)**. Nitrites/nitrates control the growth of spores, particularly from *Clostridium botulinum*. These spores are a real concern in the meat industry; in order to they can survive

normal heat processing. Under the suitable conditions, they can produce vegetative cells, which can give a lethal toxin. Nitrates undergo a chemical reaction and are reduced to nitrites. Then, nitrites react with meat protein (myoglobin), and are converted to nitrosomyoglobin (bright red). When exposed to the heat of cooking, nitrosomyoglobin is converted to nitrosohemochrome (pink pigment) **(Hyytia et al., 1997)**. Control and legislation of the adding of preservatives is essential both to assure their effectiveness and because in unsuitable amounts and conditions these meat additives can have adverse health hazards. The present study was planned for quantitative estimation of both nitrite and nitrate levels in such marketable products; either locally processed or imported ones.

MATERIALS AND METHODS

(A) Collection and preparation of the samples:

A total 115 samples of locally processed & imported cured beef and chicken products- consisted of 25 canned beef (9&16), 20 beef sausage (20&0), 15 pastirma (dried beef) (15&0), 10 beef luncheon (10&0), 5 canned beef luncheon (0&5) besides 20 canned chicken sausage (8&12) and 10 samples every of canned chicken luncheon (0&10) and chicken luncheon (10&0), respectively- purchased from different markets in several Egyptian provinces, then individually packed in a clean polyethylene bags, marked and transferred to the laboratory of Regional Center for Food and Feed /Agricultural Research Center , Cairo/ Egypt wherein they were analyzed for their contents of nitrite and nitrate by the aid of spectrophotometer according to **Sen and Donaldson (1978)**.

Each of the aforementioned samples was represented by 10 g homogenized with 40 ml distilled water by using a blender. The volume of the resultant homogenate was completed to 500 ml after adding distilled water. The obtained diluted homogenate was placed in hot - air oven at $90-95^{0}C$ / 20 min then filtered through 24 cm - filter paper (whatman, No.1).The filtered and diluted homogenate – for every sample - was submitted for quantification of their nitrite and nitrate contents.

(B) Quantification of nitrite levels in the samples:

Twenty milliliters from the filtered and diluted homogenate – from each sample - was placed in 50 ml volumetric flask and adding 2.5 ml of sulphanilamide (p - aminobenzene sulfonamide) reagent were added followed by 2.5 ml of NED reagent (N - (1 - naphltyl) – ethylene - diamine dihydrochloride) after 5 minutes then completed to 50 ml with distilled water and left for 15 minutes in the dark. Then was placed in cuvette (5 ml) and was detected spectrophotometrically at 540 nm.The purple color - appeared as a result of Griess reaction (diazo compound formation) against blank of 45 mL water and 2.5 mL of sulphanilamide reagent and 2.5 mL of NED reagent. Residual nitrite level was determined by comparison with the prepared standard curve.

Nitrite content expressed as $NaNo_2$ =

$$\frac{C \times 25000}{M \times V}$$

C = concentration of sodium nitrite in mg/L read from calibration curve that corresponds with the absorbance of the solution prepared from the sample.

M = mass in grams of sample taken.

V= volume in milliliters of aliquot portion of filtrate taken for test.

(C) Quantification of nitrate levels in the samples:

Nitrate is reduced to nitrite in the presence of cadmium granules - packed in a glass column (**Wood et al., 1967).**The obtained nitrite level for each sample was determined spectrophotometrically - as described before. The higher quantity than before for each sample was transformed into nitrate quantity by multiplying by a factor of 1.23.

Statistical analysis: The values given in each product were the mean value of three replicates.

Table (1): Nitrite and nitrate contents in cured meat products (n = 115 for all samples)

Types of analysed meat products and their samples′numbers (n)	Nitrite levels mg/kg (ppm)			Nitrate levels mg/kg (ppm)			Sum of nitrite and nitrate levels mg/kg (ppm)		
	Min.	Max.	Mean ±S.E.	Min.	Max.	Mean ± S.E.	Min.	Max.	Mean ± S.E.
Locally processed corned beef (9)	4.35	43	14.59±4.13	13.91	40.58	22.8±2.64	23.91	62.2	37.39±4.5
Imported corned beef (16)	4.07	78.37	38.94±6.98	12.32	102.5	43.88±6.62	30.77	141.9	82.82±9.2
Locally processed beef sausage (20)	6.65	82	28.72±4.34	8.93	113.01	40.6±5.94	16.49	138.7	69.33±7.92
Locally processed pastirma (15)	2.03	69	22.35±4.96	0.76	114.25	54±10.42	18.99	142.71	76.35±10.06
Locally processed beef luncheon(10)	5.22	75.5	30.63±8.28	1.99	74.7	32.81±6.4	18.99	131.7	63.43±12.46
Imported canned beef luncheon (5)	36.73	75.78	59.22±8.32	2.99	59.56	21.78±11.16	63.29	96.29	81±6.81
Locally processed canned chicken sausage (8)	7.46	47.08	27.54±4.54	7.5	44.8	16.22±4.6	22.06	91.88	43.77±7.96
Imported canned chicken sausage (12)	18.46	64.11	39.21±3.61	2.65	93.78	29.07±7.36	43.51	132.08	68.28±7.07
Imported canned chicken luncheon (10)	21.69	99.52	45.86±9.37	12.65	149.76	49.55±14.55	46.59	198.36	95.43±16.03
Locally processed chicken luncheon (10)	11.21	58.4	35.96±5.55	1.06	99.81	37.92±9.05	47.36	120.98	73.88±6.94

n= number of analysed samples Min. = minimum Max. = maximum S.E. = standard error

N.B. The maxima for nitrite and nitrate limits in cured meat are 150 & 250mg/kg (ppm), respectively (Jiménez-Colmenero and Solana, 2009)

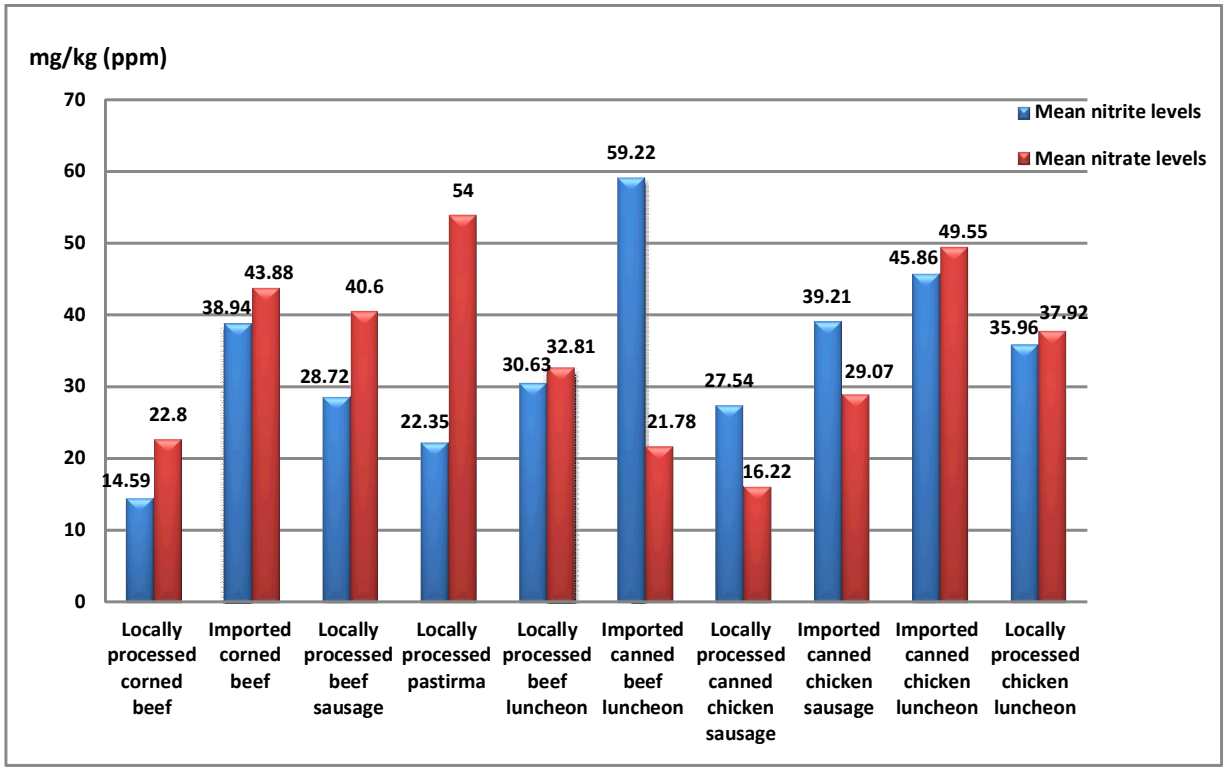

Fig (A) :Mean levels of nitrite and nitrate contents in cured meat products (n = 115 for all samples)

N.B. The maxima for nitrite and nitrate limits in cured meat are 150 & 250mg/kg (ppm), respectively (Jiménez-Colmenero and Solana, 2009).

RESULTS& DISCUSSION

Data in both Table (1) and Figure (A) revealed presence of both nitrite and nitrate residues in all 115 cured meat samples100% tested in this work. Concerning the tested locally processed corned beef samples the nitrite levels were detected as a mean ± standard error 14.59±4.13 with a range of 4.35 – 43 mg/kg, whereas these findings for nitrate contents were 22.8 ± 2.64 and 13.91 - 40.58 mg/kg in the same samples, resulted in sum of nitrite and nitrate levels in such samples were 37.39±4.5 and 23.91 - 62.2 mg/kg, respectively. On the other hand both nitrite and nitrate levels were analyzed in imported corned beef samples by levels of 38.94±6.98, 4.07 - 78.37, 43.88±6.62 and 12.32 - 102.5 mg/kg, consecutively, showed sum of nitrite and nitrate as 82.82±9.2 and 30.77 - 141.9 mg/kg in the same samples. The aforementioned data showed the contents of each of nitrite and nitrate in imported corned beef samples were approximately twice more than those found in locally processed corned beef samples. The type of meat used and the packaging technique affect nitrite contents in the finished products **(Aksu et al., 2005**), there were significant varieties between the nitrite and nitrate contents of cured meat products produced by different companies **(Sancak et al., 2008)**. The meat product nitrite contents may probably be a sequence of microbial activity, this hold the view reported by **Wolff**

and Wasserman (**1972**), who reported that the nitrite reducing bacteria may increase nitrite level in meat products by reduction of their nitrate content. By comparison, the range of nitrite levels in locally processed corned beef samples in agreement approximately with that estimated by **Dennis et al. (1990)** as 1.5 – 41.5 mg/kg**.** Whereas higher mean nitrite levels were estimated by **Nassif (1989) as** 58.95 mg/kg. These variations may be due to freezing temperatures, which considered as an important reduction of residual nitrite in cured meat products such as corned beef. Residual nitrite contents were reduced almost half after 24 h of storage at -18 ^{0} C **(Wootten et al., 1985),** nitrite levels decreased by 50-65% during manufacture and thermal processing. On the other hand approximate equal mean nitrite value of imported corned beef samples obtained by **El – Nawawi et al. (1998)** as 49.76 mg/kg and **Saad et al. (2013)** as 42.3 mg/kg, while the similar equals mean value for nitrate contents estimated by **Farag and Abd El – Fatah (2011)** as 39.82mg/kg.

Regarding the analyzed locally processed beef sausage samples the nitrite levels were quantified as a mean ± S.E. 28.72±4.34 with a range of 6.65 – 82 mg/kg, whereas similar findings for nitrate contents were 40.6±5.94 and 8.93 - 113.01 mg/kg in the such samples, resulted in sum of nitrite and nitrate levels in the same samples were 69.33±7.92 and 16.49 - 138.7 mg/kg, respectively. On contrary, the equal mean values of nitrite quantities agreed with that reported by **Honikel (2008)** as 17.9 mg/kg and **Pereira et al. (2011)** as 35.6 mg/kg, meanwhile higher mean nitrite values were detected by **Samaha (1986)** as 52.36 mg/kg, while lower mean values were detected by **Sancak et al. (2008) as** 11.48 mg/kg. The lower nitrite content in fresh sausage could be return to the reduced amount of nitrite and nitrate used in sausage production and, also other coloring ingredients that may be used to produce the attractive and desirable meat product color **(Attall, 1997)**. Meanwhile approximate equal mean value for the sum of nitrite and nitrate in such samples was quantified by **Shehata and Attia (1998)** as 76.49 mg/kg. The net changes in the nitrite and nitrate levels in sausage related to the balance between nitrite oxidation, reduction reactions, and nitrite binding to proteins, lipids and other meat components **(Honikel, 2008)**.

Concerning the tested locally processed pastirma samples the nitrite levels were detected as a mean ± standard error 22.35±4.96 with a range of 2.03– 69 mg/kg, whereas similar findings for nitrate quantities were 54±10.42 and 0.76 - 114.25 mg/kg in the same samples, resulted in sum of nitrite and nitrate levels in such samples were 76.35±10.06 and 18.99 - 142.71 mg/kg, successfully. By comparison, similar mean values for nitrite residues were detected by **Soyutemiz and Ozenir (1996) as** 15.95 mg/kg and **Sancak et al. (2008)** in Turkey as 12.53 mg/kg. The higher mean values were obtained by **El – Sayed (1998)** as 314 mg/kg, in Egypt, while lower mean values were reported by **EL – Khateib et al. (1987)** as 12 mg/kg in Turkish pastirma On the other hand approximate equal mean values for nitrate residues in the same samples were estimated by **Sancak et al. (2008)** as 58.54 ppm in Turkish pastirma and **Farag and Abd El – Fatah (2011)** as 62.54 mg/kg in Egypt. Meanwhile higher mean values quantified by **Soyutemiz and Ozenir (1996) as** 80.02 mg/kg in Bursa. High nitrite levels in pastirma could be explain by that, the product is marketed as raw salt dry meat product without any exposure of heat treatment, also salt used at curing procedure may be contaminated with nitrite and nitrate salts, pastirma has longer curing times that, allowed nitrite dissipation and nitrate conversion to nitrite (**USDA "United States Department of Agriculture" and FSIS "Food Safety and Inspection**

Service", 1995). In pastirma, the first added amounts of nitrite, and the production stages had significant effects on the residual nitrite contents.

Regarding the locally processed beef luncheon samples the nitrite levels were detected as a mean ± standard error 30.63±8.28 with a range of 5.22 – 75.5 mg/kg, whereas these findings for nitrate contents were 32.81±6.4 and 1.99 - 74.7 mg/kg in the same samples, resulted in sum of nitrite and nitrate levels in such samples were 63.43±12.46 and 18.99 - 131.7 mg/kg, respectively. On the other hand both nitrite and nitrate levels were analyzed in imported canned beef luncheon samples by levels of 59.22±8.32, 36.73 - 75.78, 21.78±11.16 and 2.99 - 59.56 mg/kg, successfully, showed sum of nitrite and nitrate as 81±6.81and 63.29 - 96.29 mg/kg in such samples. The higher mean values were quantified - in Egypt - by **El – Sayed (1998)** as 204 mg/kg, while lower value for the sum of nitrite and nitrate contents was detected by **Hna et al. (1972)** as 39 mg/kg at the beginning of storage and determined that +5 ^{0}C – cold storage. The largest decline is obtained during the manufacturing up to the end of the heating procedure, cooking time and duration of storage affected nitrite residues **(Food Standards Agency, 1998)**.

On the other hand, the similar mean nitrite values of imported canned beef luncheon were supported by that estimated by **Nassif (1989)** as 32.19 mg/kg and **El – Nawawi et al. (1998)** as 45.5 mg/kg. Meanwhile higher mean nitrite value was estimated by **Farag and Abd El – Fatah (2011)** as 159.96 mg/kg, but lower mean value was obtained by **Abd El – Daym (2005) as** 3.69 mg/kg. This variation due to nitrite and nitrate residues were lower during the storage time **(Dogruer and Guner, 2005)**, there were variations in the similar meat products results produced by different companies **(Sancak et al., 2008)**.). And also the approximate equal mean value for nitrate in the same samples found by **Farag and Abd El – Fatah (2011)** as 28.52 mg/kg.

Regarding the tested locally processed canned chicken sausage samples the nitrite quantities were quantified as a mean ± standard error 27.54±4.54 with a range of 7.46 –47.08 mg/kg, whereas these findings for nitrate quantities were 16.22±4.6 and 7.5 - 44.8 mg/kg in such samples, resulted in sum of nitrite and nitrate levels in the same samples were 43.77±7.96 and 22.06 - 91.88 mg/kg, respectively. On the other hand both nitrite and nitrate levels were estimated in imported canned chicken sausage samples by levels of 39.21±3.61, 18.46 - 64.11, 29.07±7.36 and 2.65 - 93.78 mg/kg, consecutively, showed sum of nitrite and nitrate as 68.28±7.07 and 43.51 - 132.08 mg/kg in the same samples. The previous data showed the contents of each of nitrite and nitrate in imported canned chicken sausage samples more than those found in locally processed canned chicken sausage. These results in nitrite contents of locally processed canned chicken sausage were supported by that obtained by and **El – Nawawi et al. (1998)** as 30.9 mg/kg, while lower mean value was detected by **Abd El – Daym (2005)** as 9.7 mg/kg. These mean value results in nitrite contents of imported canned chicken sausage were supported by that obtained by **Hassan (1997)** as 42.91 mg/kg (in canned meat) and **El – Nawawi et al. (1998)** as 30.9 mg/kg (in 40 canned meat samples). Where increasing the quality of meat products, reducing the nitrite contents over time, it is best that they are at least consumed after 7-10 days from production time. (**Khodadady et al., 2012)**.

Concerning the analyzed locally processed chicken luncheon samples the nitrite levels were detected as a mean ± standard error 35.96±5.55 with a range of 11.21 –58.4

mg/kg, whereas these findings for nitrate contents were 37.92±9.05 and 1.06 - 99.81 mg/kg in the same samples, resulted in sum of nitrite and nitrate levels in such samples were 73.88±6.94 and 47.36 - 120.98 mg/kg, respectively. On the other hand both nitrite and nitrate levels were quantified in imported canned chicken luncheon samples by levels of 45.86±9.37, 21.69 - 99.52, 49.55±14.55 and 12.65 - 149.76 mg/kg, successfully, showed sum of nitrite and nitrate as 95.43±16.03 and 46.59 - 198.36 mg/kg in the same samples. The aforementioned data showed the contents of each of nitrite and nitrate in imported canned chicken luncheon samples more than those found in locally processed chicken luncheon samples, this may be due to the longer storage period in imported canned chicken luncheon, cure accelerators, variations in packaging method and type **(Pegg and Shahidi, 2000)**. On contrary, approximate equal mean values of nitrite levels in locally processed chicken luncheon were supported by those obtained by **Sen and Baddoo (1997)** as 28 mg/kg, as 31 mg/kg in 1993-1995 and as 28 mg/kg in 1996 (in Canadian cured meat products), meanwhile the lower mean values were estimated by **White (1975)** as 10 ppm (in cured meat samples), the nitrite content in the finished cured meat products was usually nearly 10-20% of the first added amount **(Cassens, 1995).**

On the other hand the nearly similar range of nitrite contents in imported canned chicken luncheon was estimated **Bernal - Jorres et al. (1987)** by 23.76-105.4 ppm, in Cuba (in some cured meat products) and nearly similar mean values was obtained by **Hassan (1997)** as 42.91 mg/kg (in canned meat).

The decline in the residual nitrite contents obtained in this work due to oxidation to nitrate, beside its chemical conversion to nitric oxide, which is highly reactive and binds to myoglobin and other meat components. Meanwhile, an excess of nitrite quantities would cause feedback inhibition of nitrate reductase, and also causing higher nitrate levels **(Stahnke, 1995)**.

CONCLUSION AND RECOMMENDATIONS

In spite of none of the surveyed cured meat products samples possessed nitrite or nitrate level more than their limits recommended by **(Jiménez-Colmenero and Solana, 2009)** as 150 & 250 mg/kg, respectively, the future quantitative surveillance for both nitrite & nitrate residues in Egypt must be continuous for ensuring the safety and the good keeping quality for these products.

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الملخص العربي
التقدير الكمي للنيتريت والنترات بواسطة مقياس الطيف الضوئي في اللحوم المعالجة المصنعة

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تم تجميع إجمالي مائة وخمس عشرة عينة من مختلف منتجات اللحوم المعالجة، تلك المصنعة محليا والمستوردة والتي تم شرائها من مختلف محلات البقالة والسوبر ماركت المنتشرة في مصر، وتم تحليل محتواها لكل من النيتريت والنترات بواسطة جهاز مقياس الطيف الضوئي وعبرت ب المليجرام/ كيلو جرام (جزء من المليون). العينات التي شملتها الدراسة تكونت من خمس وعشرون من عينات اللحوم البقرية المعلبة (تسعة مصنعة محليا بالإضافة إلى ستة عشرة المستوردة منها)، عشرون من سجق اللحم البقري المصنع محليا، خمس عشرة من البسطرمة المصنعة محليا، عشر من لانشون اللحم البقري المصنع محليا، خمس من عينات لانشون اللحم البقري المستورد المعلب، عشرون من سجق لحم الدواجن المعلب (ثمان عينات محلية الصنع بالاضافة إلي إثنتا عشرة عينة مستوردة)، عشرعينات من لانشون لحم الدواجن المعلب المستورد، بالاضافة الي عشرمن عينات لانشون لحم الدواجن المصنع محليا.

حدد مقياس التحليل الطيفي الضوئي النطاق (الحد الأدني – الحد الأقصي) والقيمة المتوسطة ± الخطأ العياري لمحتوي النيتريت في عينات الحوم البقرية المحلية والمستورده و قدره ٤,٣٥- ٤٣ & ١٤,٥٩ ± ٤,١٣ مليجرام/ كيلو جرام و ٤,٠٧ – ٧٨,٣٧& ٣٨,٩٤ ± ٦,٩٨ مليجرام/ كيلوجرام، علي التوالي ، بينما وجدت هذه القيم لمحتوي النترات بتلك العينات وقدرها ١٣,٩١ – ٤٠,٥٨ &٢٢,٨ ±٢,٦٤ و١٢,٣٢ – ١٠٢,٥ &٤٣,٨٨ ±٦,٦٢مليجرام/ كيلوجرام،علي التوالي، وقد كان مجموع محتوي كل من النيتريت والنترات قدره ٢٣,٩١ – ٦٢,٢ & ٣٧,٣٩ ±٤,٥ مليجرام/ كيلوجرام في عينات اللحوم البقرية المعلبة محلية الصنع ، بجانب ٣٠,٧٧ – ١٤١,٩ & ٨٢,٨٢ ± ٩,٢ مليجرام / كيلوجرام في عينات اللحوم البقرية المعلبة المستوردة، علي التوالي.

أسفرت تقنية التحليل المذكوره سابقا عن الحد الادني ، الحد الاقصي، ومتوسط القيمه ± الخطأ العياري لمحتوي النيتريت وقدرها ٦,٦٥، ٨٢ ، و ٢٨,٧٢±٤,٣٤ مليجرام/ كيلوجرام; ولمحتوي النترات قدرها ٨,٩٣، ١١٣,٠١،و ٤٠,٦ ±٥,٩٤ مليجرام/ كيلوجرام; ولمحتوي مجموع كل من النيتريت والنترات ١٦,٤٩، ١٣٨,٧، و٦٩,٣٣±٧,٩٢ مليجرام/ كيلوجرام بعينات سجق اللحم البقري المصنع محليا، علي الترتيب. بينما هذه القيم لمحتوي النيتريت كانت ٢,٠٣، ٦٩، و ٢٢,٣٥±٤,٩٦ مليجرام/ كيلوجرام; ٠,٧٦، ١١٤,٢٥، و٥٤±١٠,٤٢مليجرام/ كيلوجرام لمحتوي النترات; وايضا ١٨,٩٩، ١٤٢,٧١، و٧٦,٣٥±١٠,٠٦مليجرام/ كيلوجرام لمجموع محتوي كل من النيتريت والنترات بعينات البسطرمة المصنعة محليا، علي التوالي.

وقد وجدت الكميات الأقل لكل من النيتريت، النترات،ومجموع كل منهما بانسجة عينات كل من لانشون اللحم البقري المصنع محليا وعينات لانشون اللحم البقري المعلب المستورد وقدرها ٥,٢٢& ٣٦,٧٣، ١,٩٩&٢,٩٩ ، و١٨,٩٩& ٦٣,٢٩ مليجرام/ كيلوجرام; بينما وجدت الكميات الأعلي لنفس المتبقيات بتلك العينات وقدرها ٧٥,٥& ٧٥,٧٨، ٧٤,٧& ٥٩,٥٦، و١٣١,٧&٩٦,٢٩ مليجرام/ كيلوجرام; بينما القيم المتوسطة ± الخطأ العياري لهذه المحتويات قدرها ٣٠,٦٣ ±٨,٢٨& ٥٩,٢٢± ٨,٣٢ ، ٣٢,٨١±٦,٤&٢١,٧٨ ±١١,١٦، و٦٣,٤٣±١٢,٤٦&٨١ ±٦,٨١ مليجرام/كيلوجرام، علي الترتيب.

وكما كشفت أنسجة عينات سجق لحم الدواجن المعلب المصنع محليا عن مدي محتوي النيتريت،النترات،ومجموع كل منهما وقدره ٧,٤٦ – ٤٧,٠٨، ٧,٥ – ٤٤,٨، و٢٢,٠٦ – ٩١,٨٨ مليجرام/ كيلوجرام بمتوسط ± الخطأ المعياري قدره ٢٧,٥٤±٤,٥٤، ١٦,٢٢±٤,٦، و٤٣,٧٧±٧,٩٦ مليجرام/ كيلوجرام، علي التوالي. بينما وجدت هذه النتائج في العينات التي فحصت من سجق لحم الدواجن المعلب وقدرها ١٨,٤٦ – ٦٤,١١، ٢,٦٥ – ٩٣,٧٨، ٤٣,٥١ – ١٣٢,٠٨بمتوسط ± الخطأ المعياري وقدره٣٩,٢١±٣,٦١، ٢٩,٠٧± ٧,٣٦، و ٦٨,٢٨±٧,٠٧ مليجرام/ كيلوجرام ، علي التوالي.

وقد أسفرت نتائج التحليل الطيفي لعينات لانشون لحم الدواجن المعلب المستورد عن القيم المتوسطة ± الخطأ المعياري والمدي (الحد الأدني – الحد الأقصي) وقدرها ٤٥,٨٦ ± ٩,٣٧و ٢١,٦٩ – ٩٩,٥٢ مليجرام/كيلوجرام لمحتوي النيتريت بيها، ٤٩,٥٥± ١٤,٥٥و ١٢,٦٥ – ١٤٩,٧٦مليجرام/ كيلوجرام لمحتوي النترات بتلك العينات، بالإضافة إلي ٩٥,٤٣±١٦,٠٣و ٤٦,٥٩ – ١٩٨,٣٦ مليجرام/ كيلوجرام لمحتوي مجموعهما بنفس العينات، علي التوالي. بينما وجدت هذه النتائج في أنسجة عينات لانشون لحم الدواجن المصنع محليا قدرها ٣٥,٩٦±٥,٥٥ و ١١,٢١ – ٥٨,٤ مليجرام / كيلوجرام لمحتوي النيتريت، ٣٧,٩٢±٩,٠٥و ١,٠٦ – ٩٩,٨١ لمحتوي النترات بيها، إضافة إلي ٧٣,٨٨ ±٦,٩٤ و ٤٧,٣٦ – ١٢٠,٩٨ميلجرام/ كيلوجرام لمجموع محتوي كل منهما، علي التوالي.

إستعراضا للنتائج السابقة التي تم الحصول عليها، لا شئ من عينات اللحوم المعالجة المحفوظة بإضافة كل من النيتريت أو النترات إحتوت علي كميات أكثر من الحدود المسموح بها لكل منهما ١٥٠&٢٥٠ مليجرام/ كيلوجرام، علي التوالي. وأيضا تناولنا خطورة إضافة كل من النيتريت والنترات بكميات أعلي من الحد المسموح به في اللحوم المعالجةعلي الصحة العامة في مصر في هذه الأطروحة.